#405

MARINER 10

INTERPLANETARY EMISSIONS

73-085A-05A

MARINER 10

INTERPLANETARY EMIS H-HE, ON TAPE

73-085A-05A

THIS DATA SET HAS BEEN RESTORED. IT ORIGINALLY CONTAINED ONE 7-TRACK, 800 BPI TAPE WRITTEN IN BCD. THERE IS ONE RESTORED TAPE WRITTEN IN ASCII. THE DR TAPE IS A 3480 CARTRIDGE AND THE DS TAPE IS 9-TRACK, 6250 BPI. THE TIME SPANS COULD NOT BE VERIFIED. THE ORIGINAL TAPE WAS CREATED ON AN HP2100 COMPUTER AND WAS RESTORED ON AN IBM 9021 COMPUTER. THE DR AND DS NUMBER ALONG WITH THE CORRESPONDING D NUMBER AND TIME SPAN IS AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR005509	DS005509	D030415	1	11/06/73
			2	12/07/73
			3	12/19/73
			4	01/28/74

REQ. AGENT	RAND NO.	ACQ. AGENT
VJP	RC8202	RNH

MARINER 10

INTERPLANETARY EMISSIONS

73-085A-05A

This data set catalog consists of 1 Mariner 10 data tape. The tape is 800 BPI, BCD, 7 track and contains 4 files. The tape was created on an HP2100 computer.

The time span is as follows:

D#	C#	FILE	TIMESPAN
D-30415	C-19396	1	11/06/73
		2	12/07/73
		3	12/19/73
		4	1/28/74

II. SPACECRAFT ROLL MANEUVER

In order to provide a calibration point for the cruise science instruments on the Mariner 10 spacecraft, several roll calibration maneuvers (RCM's) were performed. The technique was to disable the star tracker which provided roll stabilization and caused the spacecraft to roll about the spacecraft-sun line. The roll motion modulated the signals due to the interplanetary medium and verified the functioning of the cruise science instruments. The UVS was operated during these maneuvers and measured the intensity variation of the resonance-scattered H Ly-α 1216 Å and He 584 Å emission from the interplanetary gas as the field of view moved over the celestial sphere. Although many calibrations were planned, only four were actually performed because of spacecraft technical problems.

The rolling motion of the spacecraft caused the 0.13 x 3.6 degree field of view of the UVS to move parallel to the long axis through the sky.
Since one axis of the scan platform (clock axis) was directed to the sun, and the other axis (cone axis) was perpendicular to it, the roll was similar to a slew in clock at a constant cone angle. This motion resulted in observations of a strip 0.13° in half-width at the preset cone angle and gave an effective resolution of 3.6° in the direction of the motion. The roll rate was about 0.18°/s and our sample period was 0.6 seconds, so the angular motion was about 0.11° per sample. In order to examine the weak emission, the data was summed over 21-second intervals, or 2.3° per sample. Star positions were determined at higher spatial resolutions so that stellar contamination could be removed.

The Cartesian position vectors of the Mariner 10 spacecraft relative to a heliocentric space-fixed coordinate system, earth true orbital of date, are given in Table 1. These orbital positions are shown projected onto a view of the ecliptic plane in Figure 1. The general direction of the flow of the interstellar wind through the planetary system is shown in Figure 1 with the suggestion of gravitational focusing of neutral helium and possible divergence of the hydrogen stream. The shaded areas extending from the spacecraft position indicate the range of observations in cone angle which were acquired on each of the RCM's; they should be understood to be a section of a complete cone generated about the spacecraft-sun axis.

III. DATA ANALYSIS

A standard method of extracting the hydrogen and helium intensities was used for all of the data and was performed automatically. Detectors identical to those for 584 Å and 1216 Å emissions were located at the wavelength positions 304 Å, 430 Å, 740 Å and 869 Å (see Broadfoot _et al_. 1977). The signal recorded from these detectors while viewing the sky was a good measure of the instrument characteristics from the point of view of internal scattering, noise and dark current; they were used as background control monitor channels. By an examination of continuous data from a three-week period, it was established that the noise level recorded in the 584 Å channel was consistently equal to one-fifth the sum of the signals recorded in these 4 monitor channels. On this basis, the signal to noise ratio in the 584 Å channel was about 5. The signal in the 1216 Å channel was very strong and the background signature could not be detected in that data. The same noise compensation was used for both the hydrogen and helium emissions and gave a hydrogen signal to noise ratio of about 14. The spectrometer efficiency at 584 Å and 1216 Å was such that a 1 Rayleigh (R) emission produced 0.36 and 0.033 photo-electron events per second, respectively. The 21-second sums of the data given here were smoothed with a third order expansion binomial function, 1,4,6,4,1. We estimate a single point statistical error on a 5 R signal of 584 Å emission to be about ±10% (σ) in this smooth data. Similarly, at a signal level of 200 R of 1216 Å emission, the statistical error was about ±5%.

Most of the pertinent observational information* has been included on the figures containing the data, Figures 2 through 5. The observations were made during roll calibration maneuvers on 6 November 1973 (RCM1), 7 December 1973 (RCM3), 19 December 1973 (RCM4) and 28 January 1974 (RCM7). At the top of each plot, the cone angle of the field of view was given with the

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*These raw data are available from the National Space Science Data ~~Bank~~ Center in Greenbelt, Maryland.

'start roll' and 'stop roll' times marked. In most cases the scan platform was moved after each complete roll. At the bottom of each figure, the time was given in spacecraft event time (SCET) for the beginning of the first 42-second data frame. In each plot of the hydrogen intensity, star positions were indicated numbers; the emission sources which correspond to these numbers were given in the tables related to the figures (Tables 2 through 5). The stellar and planetary sources appeared clearly in the long wavelength channels of the instrument as the field of view crossed the sources. The pointing information was not good enough to indicate where the source was with respect to the center of the field of view. We list these sources as a contamination of the interplanetary emission and have indicated the apparent intensity on a scale from 1 to 10 as a guide to the level of contamination.

When the data are examined carefully, the following points are noteworthy. At the beginning of RCM1, Figure 2, the spacecraft was referenced to Vega in roll. Subsequently, the roll maneuver was stopped with a Canopus reference. The scan platform was oriented toward the earth at the beginning of the roll; the apparent excess in 1216 Å emission was due to the earth's geocorona, and the appearance of the earth in the two successive rolls was due to the size of the geocoronal envelope around the earth. The high intensity in helium was caused by the coincidence that the downwind axis of the interstellar wind was near our field of view.

TABLE 2. RCM1 CONTAMINATION SOURCES

IDENTIFICATION (See Fig. 2)	BORESIGHT R.A.	DIRECTION DEC.	RELATIVE INTENSITY	YALE CATALOG	NAME
1 a)			7.9		Earth
b)			10^+		Earth
c)			4.3		Earth
d)			2.1		Earth
2	290.9	39.0	2.1	7298	20 η Lyr
3 a)	118.6	-50.0	2.5	3207	γ^2 Vel
b)	121.8	-47.6	10^+	3207	γ^2 Vel
c)	122.8	-47.4	1.0	3207	γ^2 Vel
4	286.5	42.2	2.4	7258	
5	291.1	30.6	6.8	7372	2 Cyg

TABLE 3. RCM3 CONTAMINATION SOURCES

IDENTIFICATION (See Fig. 2)	BORESIGHT R.A.	DIRECTION DEC.	RELATIVE INTENSITY	YALE CATALOG	NAME
1 a)	339.8	10.8	5.6	8634	42 ζ Peg
b)	339.8	10.8	4.0	8634	42 ζ Peg
2 a)	122.5	-47.2	10^{+}	3207	γ^2 Vel
b)	122.5	-47.2	7.9	3207	γ^2 Vel
c)	121.0	-48.3	10	3207	γ^2 Vel
d)	119.5	-49.5	7.5	3207	γ^2 Vel
3	349.0	-9.4	3.3	8858	93 ψ^2 Aqr
4 a)	120.7	-40.2	2.5	3165	ζ Pup
b)	120.7	-40.2	2.1	3165	ζ Pup
c)	120.7	-40.2	2.1	3165	ζ Pup
5	318.6	47.6	4.2	8136	

TABLE 4. RCM4 CONTAMINATION SOURCES

IDENTIFICATION (See Fig. 2)	BORESIGHT R.A.	DIRECTION DEC.	RELATIVE INTENSITY	YALE CATALOG	NAME
1 a)	288.4	23.4	1.1	7318	2 Vul
b)	288.4	23.4	0.9	7318	2 Vul
2 a)	197.0	-49.6	0.7	4942	ξ^2 Cen
b)	197.0	-49.6	1.5	4942	ξ^2 Cen
c)	197.0	-49.6	1.1	4942	ξ^2 Cen
d)	197.0	-49.6	0.6	4942	ξ^2 Cen
e)	197.0	-49.6	1.5	4942	ξ^2 Cen
3 a)	198.8	-59.9	6.2	5034-5035	
b)	198.8	-59.9	3.0	5034-5035	
c)	198.8	-59.9	3.6	5034-5035	
d)	198.8	-59.9	4.0	5034-5035	
e)	198.8	-59.9	10.0	5034-5035	

TABLE 5. RCM7 CONTAMINATION SOURCES

IDENTIFICATION (See Fig. 2)	BORESIGHT R.A.	DIRECTION DEC.	RELATIVE INTENSITY	YALE CATALOG	NAME
1	238.5	-23.8	1.2	5907	
2	297.4	47.6	1.5	7589	
3	204.7	-53.5	10^+	5132	ε Cen
4	39.6	-1.2	10.0	779	82 δ Cet
5	130.9	-59.6	2.1	3457	
6	159.7	-56.9	1.3	4173	
7	101.8	-37.6	1.4	2510	
8	95.0	-29.5	1.0	2282-2397	ζ CMa
9	116.7	-40.2	2.6	3025-3026	
10	206.9	50.0	10^+	5191	82 η UMa
11	101.0	-36.6	1.4	2538	13 κ CMa
12	83.5	18.4	1.1	1858	120 Tau

FIGURES

Figure 1. An ecliptic projection of the Mariner 10 spacecraft trajectory and planet orbits. Orbital positions of the four RCM's are marked. The lines and shading originating at these positions indicate the cross section of the conic scan generated by the roll. Orbital parameters are given in Table 1. The direction of the interstellar wind is illustrated.

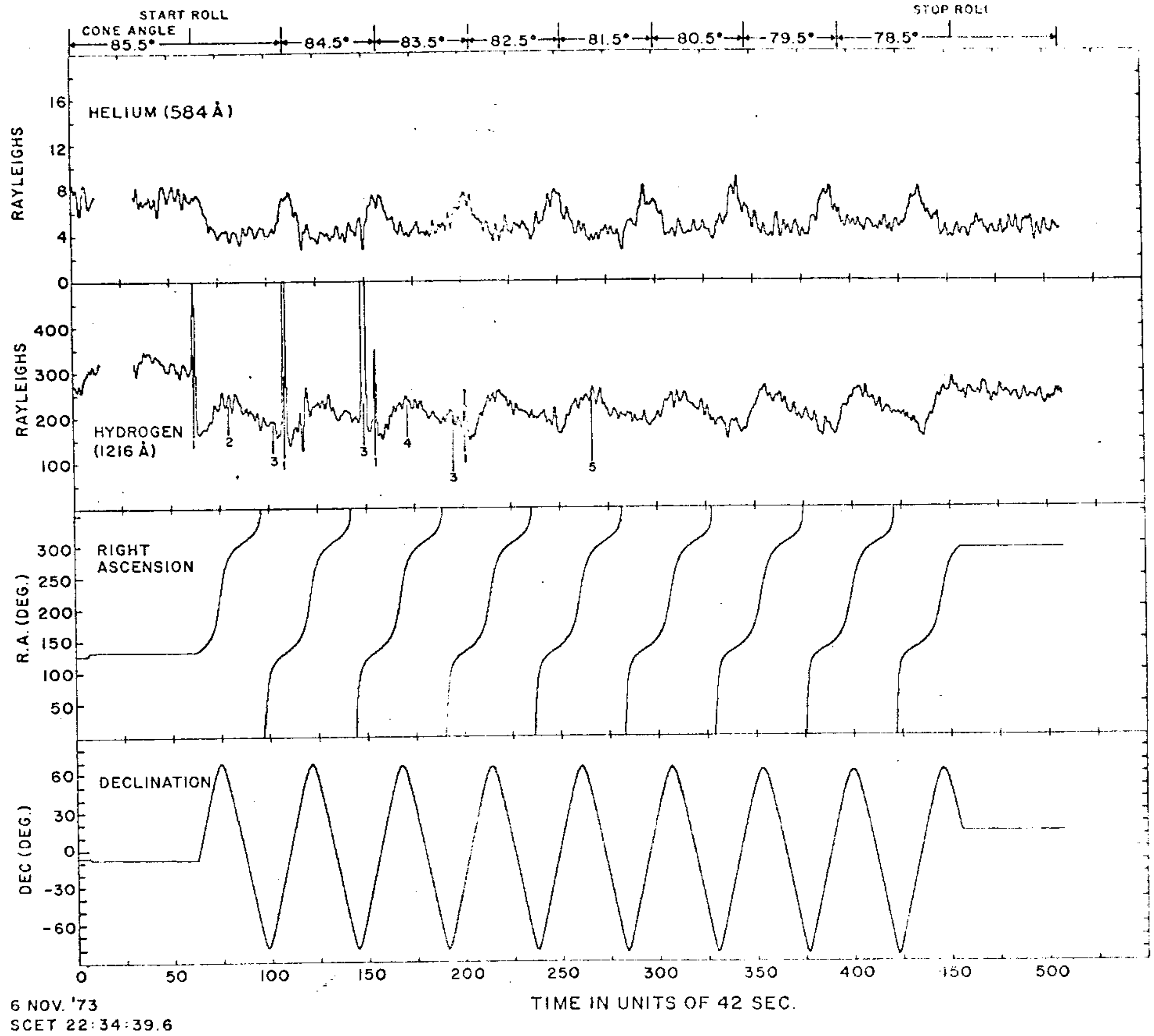
Figure 2. Data from RCM1. The identification of the contaminating point sources (earth and stars), which were numbered in the hydrogen plot, were listed in Table 2.

Figure 3. Data from RCM3. The identification of the contaminating point sources (earth and stars), which were numbered in the hydrogen plot, were listed in Table 3.

Figure 4. Data from RCM4. The identification of the contaminating point sources (earth and stars), which were numbered in the hydrogen plot, were listed in Table 4.

Figure 5. Data from RCM7. The identification of the contaminating point sources (earth and stars), which were numbered in the hydrogen plot, were listed in Table 5.

Figure 6. The boresight track over the celestial sphere of the ultraviolet spectrometer field of view during RCM7.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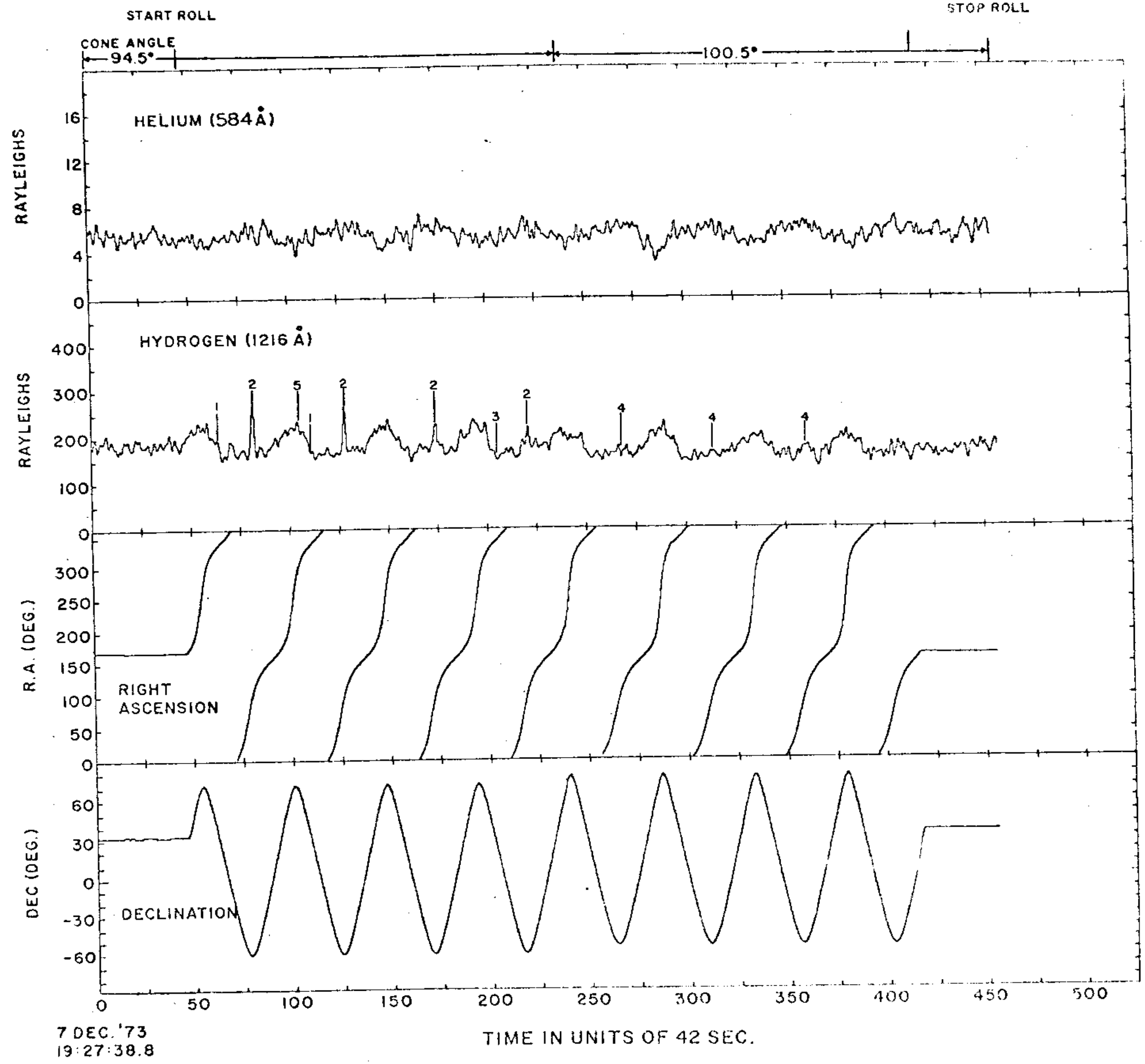
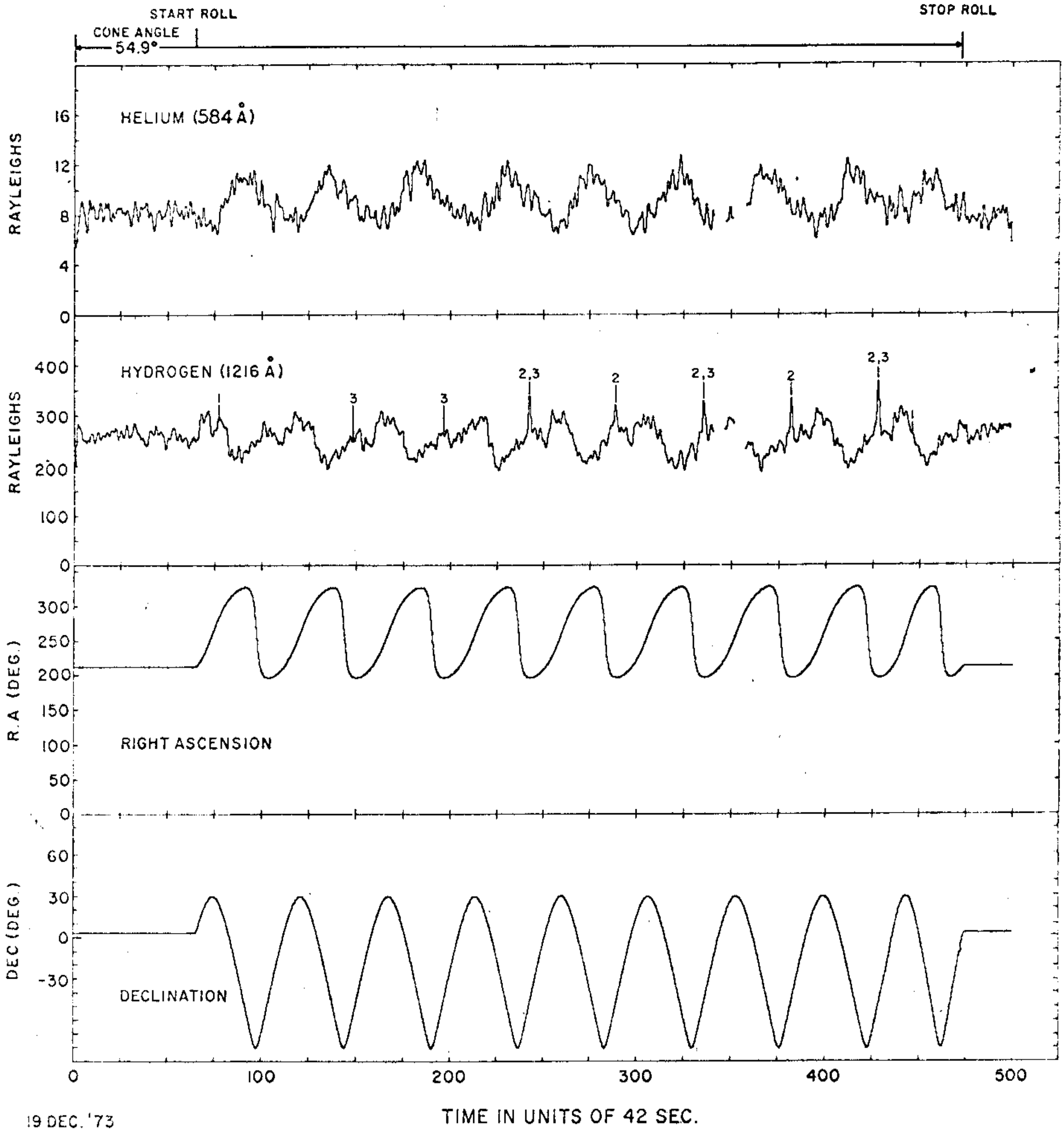
CONE ANGLE
85.5°
84.5°
83.5°
82.5°
81.5°
80.5°
79.5°
78.5°
STOP ROLL
HELIUM (584 Å)
RAYLEIGHS
HYDROGEN (1216 Å)
RAYLEIGHS
RIGHT ASCENSION
R.A. (DEG.)
DECLINATION
DEC (DEG.)
TIME IN UNITS OF 42 SEC.
6 NOV. '73
SCET 22:34:39.6

FIGURE 2



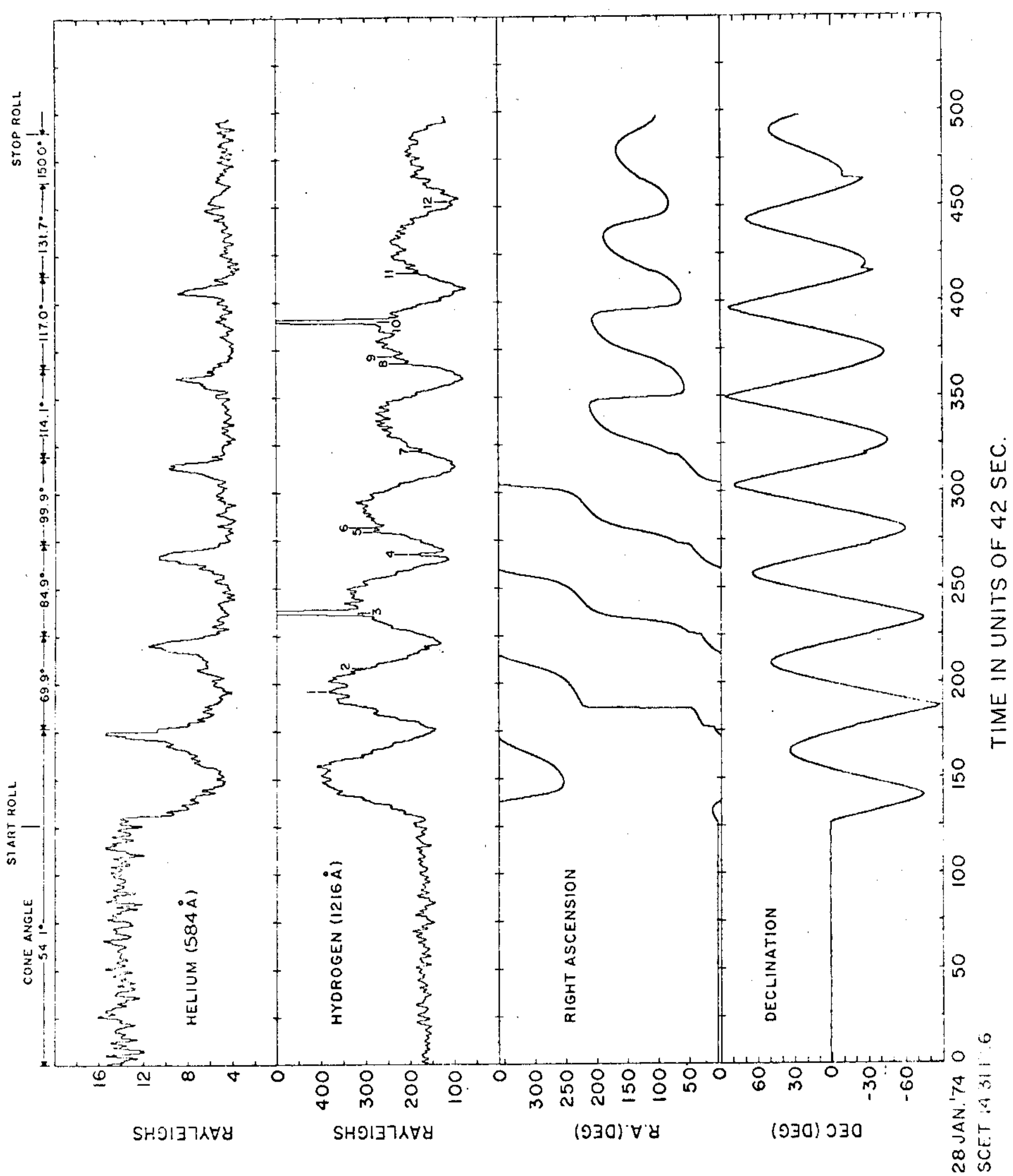
START ROLL
STOP ROLL
CONE ANGLE
94.5°
100.5°
HELIUM (584 Å)
RAYLEIGHS
HYDROGEN (1216 Å)
RAYLEIGHS
R.A. (DEG.)
RIGHT ASCENSION
DEC (DEG.)
DECLINATION
7 DEC. '73
19:27:38.8
TIME IN UNITS OF 42 SEC.

FIGURE 3



19 DEC. '73
SCET 19:14:21.3

FIGURE 5



CONE ANGLE
START ROLL
STOP ROLL
54.1°
69.9°
84.9°
99.9°
114.1°
117.0°
131.7°
150.0°
HELIUM (584 Å)
HYDROGEN (1216 Å)
RIGHT ASCENSION
DECLINATION
RAYLEIGHS
R.A. (DEG)
DEC (DEG)
TIME IN UNITS OF 42 SEC.
28 JAN. '74

PROGRAM BCD, VERSION 1.3 RELEASED: 1 JUNE 1976
HP 2100 VERSION WRITTEN AT MARINER PROGRAMS COMPUTING FACILITY
ASSOCIATION OF UNIVERSITIES FOR RESEARCH IN ASTRONOMY, INC.

File 1

SUBJECT: ROLL CALIBRATION MANEUVER 1 (RCM 1)

START: FDSC = 8101 1973/310 22:34:39.643 (SCET)

STOP: FDSC = 8625

COMPRESSION: 35 (21.0 SEC/SAMPLE)

SPEC CHANNELS OUTPUT TO TAPE: 2 5 9

CH 2 - BACKGROUND PHOTO-ELECTRON EVENTS PER 21 SECONDS
CH 5 - HELIUM PHOTO-ELECTRON EVENTS PER 21 SECONDS
CH 9 - HYDROGEN PHOTO-ELECTRIN EVENTS PER 21 SECONDS

CALIBRATION: 1 RAYLEIGH OF EMISSION YIELDS:

HE (584A): 0.36 PHOTOELECTRON EVENTS/SEC
H (1216A): 0.033 PHOTOELECTRON EVENTS/SEC

GEOM CHANNELS OUTPUT TO TAPE: RA AND DEC

FORMAT OF EACH RECORD ON THE BCD TAPE: 3I5,1X,2E10.4

TOTAL NUMBER OF RECORDS: 1050.

DATA: 2/17/77 TAPE CREATED BY: DRM

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13	72	208	.1280E+03-.5710E+01	(3)
14	68	192	.1280E+03-.5686E+01	(4)
16	76	192	.1280E+03-.5662E+01	(5)
12	84	192	.1280E+03-.5647E+01	(6)
9	64	208	.1280E+03-.5631E+01	(7)
11	64	208	.1280E+03-.5617E+01	(8)
15	52	176	.1280E+03-.5603E+01	(9)
12	56	192	.1280E+03-.5589E+01	(10)
14	64	208	.1280E+03-.5576E+01	(11)
11	64	208	.1280E+03-.5557E+01	(12)
11	84	208	.1279E+03-.5537E+01	(13)
9	72	224	.1309E+03-.6380E+01	(14)
12	76	208	.1339E+03-.7222E+01	(15)
16	80	224	.1339E+03-.7210E+01	(16)
14	72	240	.1339E+03-.7199E+01	(17)
18	56	224	.1340E+03-.7186E+01	(18)
15	72	224	.1340E+03-.7174E+01	(19)
17	64	224	.1340E+03-.7161E+01	(20)
20	72	256	.1340E+03-.7148E+01	(21)
14	68	224	.1340E+03-.7134E+01	(22)
16	72	224	.1340E+03-.7121E+01	(23)
16	68	224	.1340E+03-.7107E+01	(24)
15	80	224	.1340E+03-.7093E+01	(25)
13	64	224	.1341E+03-.7084E+01	(26)
11	64	224	.1341E+03-.7076E+01	(27)
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0	0	0	.1341E+03-.6956E+01	(34)
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0	0	0	.1342E+03-.7003E+01	(42)
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0	0	0	.1341E+03-.7148E+01	(60)
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N-50415
11/6/73 - 1/28/74

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TAPE NO.   1                FILE NO.   3
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35 108 2240 .2093E+03 .6040E+01

TAPE NO. 1 FILE NO. 3
RECORD 9 LENGTH 36
31 100 2240 .2093E+03 .6040E+01

TAPE NO. 1 FILE NO. 3
RECORD 10 LENGTH 36
34 100 2080 .2092E+03 .6009E+01

TAPE NO. 1 FILE NO. 3
RECORD 991 LENGTH 36
36 100 2407 .2139E+03 .2969E+01

TAPE NO. 1 FILE NO. 3
RECORD 992 LENGTH 36
35 84 2249 .2139E+03 .3002E+01

TAPE NO. 1 FILE NO. 3
RECORD 993 LENGTH 36
35 104 2242 .2139E+03 .3035E+01

TAPE NO. 1 FILE NO. 3
RECORD 994 LENGTH 36
36 104 2405 .2139E+03 .3069E+01

TAPE NO. 1 FILE NO. 3
RECORD 995 LENGTH 36
38 100 2249 .2140E+03 .3102E+01

TAPE NO. 1 FILE NO. 3
RECORD 996 LENGTH 36
45 100 2242 .2140E+03 .3136E+01

TAPE NO. 1 FILE NO. 3
RECORD 997 LENGTH 36
39 84 2406 .2140E+03 .3170E+01

TAPE NO. 1 FILE NO. 3
RECORD 998 LENGTH 36
35 88 2450 .2140E+03 .3204E+01

TAPE NO. 1 FILE NO. 3
RECORD 999 LENGTH 36
39 100 2084 .2140E+03 .3239E+01

TAPE NO. 1 FILE NO. 3
RECORD 1000 LENGTH 36
36 104 2409 .2140E+03 .3274E+01

TAPE NO. 1 FILE NO. 4
RECORD 1 LENGTH 36
11 108 1124 .6021E+01 .7403E+00

TAPE NO. 1 FILE NO. 4
RECORD 2 LENGTH 36
7 128 963 .6023E+01 .7296E+00

TAPE NO. 1 FILE NO. 4
RECORD 3 LENGTH 36
7 128 1606 .6026E+01 .7188E+00

TAPE NO. 1 FILE NO. 4
RECORD 4 LENGTH 36
8 108 1128 .6025E+01 .7205E+00

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TAPE NO.   1                 FILE NO.   4
RECORD    5                  LENGTH    36
  12  112  1445 .6025E+01 .7223E+00

TAPE NO.   1                 FILE NO.   4
RECORD    6                  LENGTH    36
  11  120  1123 .6025E+01 .7216E+00

TAPE NO.   1                 FILE NO.   4
RECORD    7                  LENGTH    36
   8  120  1126 .6025E+01 .7210E+00

TAPE NO.   1                 FILE NO.   4
RECORD    8                  LENGTH    36
  11   92  1440 .6032E+01 .6954E+00

TAPE NO.   1                 FILE NO.   4
RECORD    9                  LENGTH    36
  12  108  1284 .6038E+01 .6697E+00

TAPE NO.   1                 FILE NO.   4
RECORD   10                  LENGTH    36
   8  116  1287 .6042E+01 .6527E+00

TAPE NO.   1                 FILE NO.   4
RECORD   1041                LENGTH    36
  24   72  2727 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1042                LENGTH    36
  23   80  3207 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1043                LENGTH    36
  25   64  3207 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1044                LENGTH    36
  26   76  3687 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1045                LENGTH    36
  32   80  3647 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1046                LENGTH    36
  28   60  3847 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1047                LENGTH    36
  43   76  5447 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1048                LENGTH    36
  44   76  5447 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1049                LENGTH    36
  36   88  4967 .8341E+02-.5707E+01

TAPE NO.   1                 FILE NO.   4
RECORD   1050                LENGTH    36
  38   88  5447 .8341E+02-.5707E+01

***** JOB DONE.
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